國立臺灣大學 104 學年度碩士班招生考試試題

1. Consider the given Routh table, which is used to determine if a control system is stable.
   (1) Write the characteristic equation of the control system.
   (2) By completing the Routh table, obtain the values of parameters a, b, c, d, and e listed in the Routh table.
   (3) Determine the roots on the $j\omega$-axis of the control system.
   【計分：10 分，每個答案 1 分】

Routh table

s^7	1	2	−1	−2
s^6	1	2	−1	−2
s^5	a	b	−1	0
s^4	1	−1	−3	0
s^3	7	8	0	0
s^2	c	−21	0	0
s^1	d	0	0	0
s^0	e	0	0	0

2. Consider the open-loop system shown in **Fig. 1-(a)**, where $\frac{d^2y}{dt^2}-\frac{g}{l}y=z$ and $f(t)=\tau\frac{dz}{dt}+z$. Our goal is to stabilize this system so the closed-loop feedback control will be defined as shown in the block diagram in **Fig. 1-(b)**. Assuming $f(t)=K_Pe+K_D\frac{de}{dt}$.
   (1) Find the open-loop transfer function $G(s)$.【計分：2 分】
   (2) Find the closed-loop transfer function $M(s)=Y(s)/R(s)$.【計分：2 分】
   (3) Suppose $\frac{g}{l}=10$ and $\tau=0.2$. Find the range of K_P and K_D in which the closed-loop feedback control system is stable.【計分：3 分】
   (4) Find the sensitivity $S^M_{K_P}$.【計分：3 分】

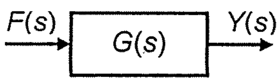


Fig. 1-(a)

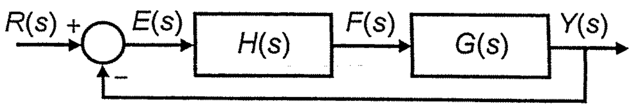


Fig. 1-(b)

3. Refer to the signal flow graph (SFG) shown in **Fig. 2**.
   (1) Write the set of algebraic equations that can construct the given SFG.【計分：5 分】
   (2) Find the transfer functions $\left.\frac{Y_6}{Y_1}\right|_{Y_7=0}$ and $\left.\frac{Y_6}{Y_7}\right|_{Y_1=0}$ for the SFG shown in **Fig. 2**.【計分：8 分】

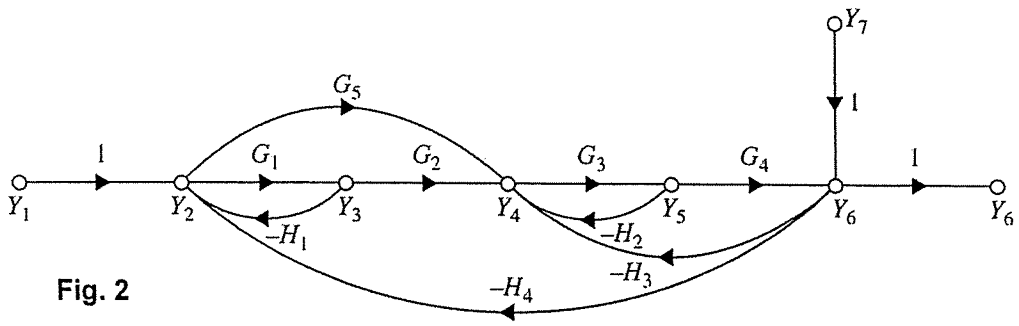


Fig. 2

4. Refer to the rotational system shown in **Fig. 3**.
   (1) Write the torque equations of the system.【計分：3 分】
   (2) Draw the state diagram for the rotational system by using a minimum number of integrators.【計分：4 分】
   (3) Write the state equation from the state diagram.【計分：4 分】
   (4) Find the transfer functions $\Theta_1(s)/T(s)$ and $\Theta_2(s)/T(s)$ for the shown system.【計分：6 分】

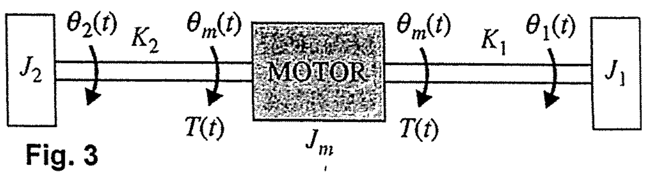


Fig. 3

見背面

5. 針對下列線性常係數連續系統狀態方程式求解

(1) 假設系統狀態方程式為

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}\begin{bmatrix}x_1(t)\\ x_2(t)\end{bmatrix}$$

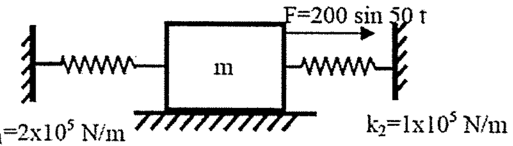
試求狀態方程式的解【計分：5 分】

(2) 若系統狀態方程式改變為

$$\begin{bmatrix}\dot{x}_1\\ \dot{x}_2\end{bmatrix}=\begin{bmatrix}0 & 1\\ -2 & -3\end{bmatrix}\begin{bmatrix}x_1(t)\\ x_2(t)\end{bmatrix}+\begin{bmatrix}0\\ 1\end{bmatrix}u(t)$$

且$[x_1(0)\quad x_2(0)]=[2\quad 1]$，試求在 u(t)=1(t)作用下之狀態方程式的解【計分：5 分】

6. m 值為何？將造成下列系統共振。其中 F 是施加的外力，k_1, k_2為彈簧常數。【計分：10 分】



7.一個系統的轉移函數如下所示。【計分：10 分】

$$G(s)=\frac{K(s+2)}{s^2+(4+K)s+2K}$$

其中K為常數。

對於不同的K值，試描述此一系統之動態特性。

8.假設有一個系統可以一階微分方程式描述如下。【計分：10 分】

$$1.25\frac{dy}{dt}+y=f(t),\quad \text{其中輸入信號為 } f(t)=3\sin(\omega_0 t)\ \text{mV}$$

當$\omega_0 \geq \omega_c$時，其輸出訊號的振幅將衰減至小於0.01mV，請問ω_c為何？

9. 一單位迴授控制系統之開迴路轉移函數如下。

$$G(s)=\frac{1}{0.5s+1}$$

假如輸入為: $r(t)=10\sin(4t+60^0)+20\cos(4t+45^0)$

(1) 求解系統的穩態反應 c(t)。【計分：5 分】

(2) 求解系統的穩態誤差 e(t)。【計分：5 分】 (註：$\tan^{-1}(1/3)=18.4^0$)

試題隨卷繳回